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FIELD INVESTIGATION
PHOTOGRAPH ALBUM
SITES 12, 68, 75, 76, 84, 85, AND 87

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0314

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LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing Materials
BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CTO	Contract Task Order
DEHNR	North Carolina Department of Environment, Health, and Natural Resources
DO	Dissolved Oxygen
DoD	Department of Defense
DoN	Department of the Navy
EM	Electromagnetic Conductivity
EMD	Environmental Management Division
EOD	Explosive Ordnance Disposal
ESE	Environmental Science and Engineering, Inc.
FFA	Federal Facilities Agreement
GPM	Gallons Per Minute
GPS	Global Positioning System
ID	Inside Diameter
OD	Outside Diameter
PE	Polyethylene
PID	Photoionization Detector
PVC	Polyvinyl Chloride
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
NPL	National Priorities List
PCB	Polychlorinated Biphenyls
RI	Remedial Investigation
RRR	Relative Risk Ranking
SPT	Standard Penetration Test
STOLS	Surface Towed Ordnance Locator System

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

TLZ	Tactical Landing Zone
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

Marine Corps Base (MCB), Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) effective November 4, 1989 (54 Federal Register 41015, 1989). Subsequent to this listing, the United States Environmental Protection Agency (USEPA) Region IV, the North Carolina Department of Environment, Health, and Natural Resources (DEHNR), and the United States Department of the Navy (DoN) entered into a Federal Facilities Agreement(FFA) for MCB Camp Lejeune.

The FFA identified 23 sites where Remedial Investigation/Feasibility Study (RI/FS) activities were to be conducted. Four of the seven sites involved with this current Pre-RI Investigation are listed in the FAA. The four sites include: Site 68 (Rifle Range Dump), Site 75 (MCAS Basketball Court), Site 76 (MCAS Curtis Road), and Site 87 (MCAS Officer's Housing Area). The three additional sites, included as part of this Pre-RI Investigation, were included as a result of finding potential contamination concerns revealed during normal operational activities associated with each site. The three additional sites include: Site 12 (Explosive Ordnance Disposal Area), Site 84 (Building 45 Area), and Site 85 (Camp Johnson Battery Dump). This photo album describes Pre-RI field activities conducted at all seven of the sites. Locations for each site can be seen on Figure 1-1.

1.1 Purpose and Format of the Field Investigation Photograph Album

The primary purpose of the Field Investigation Photograph Album is to provide the Navy and Marine Corps with an overview of the Pre-RI field activities that have been conducted at the seven investigative areas. The field investigation was conducted by Baker Environmental, Inc. (Baker) for the DoN during August and October in 1995 and January and February in 1996. This album contains photographs of the sites and the various field investigation activities that were conducted during the Pre- RI.

The Field Investigation Photograph Album is formatted to allow ease of review. Section 1.0 provides the introduction, purpose, and format of the photograph album. Section 2.0 provides a brief description of the sites and a summary of the known or suspected waste disposal activities. Photographs have been included within Section 2.0 that illustrate present site conditions. Section 3.0 describes the various field investigations conducted at the seven sites. Representative photographs of all field investigation activities (e.g. Soil Investigation, Groundwater investigation) are included in this section. Corresponding 35 millimeter color slides of all photographs contained in this album are provided in Appendix A.

2.0 SITE BACKGROUND AND SETTING

The following sections provide a site description and site history for the seven sites that comprised this Pre-Remedial Investigation. The seven investigation areas include Sites: 12, 68, 75, 76, 84, 85, and 87.

2.1 Site 12 - Explosive Ordnance Disposal Area

2.1.1 Site Location and Setting

Site 12 is located in the area referred to as Camp Lejeune Mainside. The site is located approximately two miles northeast of Sneads Ferry Road and State Route 172 (Figure 1-1). The site is accessed from the west via a unimproved road (i.e. dirt road) that turns east from Sneads Ferry Road at Fire Tower M. The Site 12 study area comprises nearly two acres of the ten acre EOD detonation area. The detonation area's relief is flat with a very white to gray sandy surface cover, and is sparsely vegetated with grasses and occasional small brush. Situated within the area are several large pieces of old and rusted equipment including a bulldozer blade and a cannon which remain recognizable. An active tank trail runs along the northern wedge of the site.

Ordnance disposal operations at Site 12 have resulted in extensive ground disturbance. During field activities it was noted that the ground surface was scared by numerous detonation craters. These craters ranged from two to 15 feet in diameter and up to six feet in depth.

2.1.2 Site History

The site is within an area where unserviceable or defective ordnance is disposed of through burning or exploding. This area has been used to conduct these practices since the early 1960s and is in current use. During a disposal exercise conducted in 1992, an explosive crater (approximately eight feet deep) uncovered an oily sheen, and a suspected petroleum odor was noted. Petroleum fuels have not been documented to be used in the explosive practices. The area surrounding the site has no documented past or present existence of fuel storage tanks. Until the time of this investigation, no documentation existed either to deny or confirm if a release occurred in this area.

During the field activities at Site 12, Baker learned of disposal procedures through casual conversations with on-site EOD personnel. It was related that the disposal of small arms ammunition was carried out by piling up the rounds, sometimes inside a crater from a past disposal, dousing the pile with diesel fuel and exploding the pile with a small explosive. Among the ordnance that was disposed of was white phosphorous ammunition. Baker also learned that the range was used, for a short time, as a target range for aircraft to drop "dummy" bombs onto.

Photo #1 provides an indication of the vastness of Site 12. The ground surface is soft, white sand with grassy vegetation.

Photo #2. The EOD representative inspects an unexploded shell discovered only a few feet away from a proposed sample location.

2.2 Site 68 - Rifle Range Dump

2.2.1 Site Location and Setting

Site 68 is located with in the Rifle Range Area of Camp Lejeune (Figure 1-1). The investigative area of Site 68 is located to the west of Range Road, approximately 200 feet west of the Rifle Range Water Treatment Plant, and about 800 feet east of Stone Creek. The entire suspected disposal area is reported to be less than five acres in size.

Site 68 is accessed from the east, along the northern edge of the Rifle Range parking area. An improved dirt road leads into the center of the suspected disposal area. With the exception of the main road (Loop Road) which loops through the center of the site, and a few smaller paths, the surrounding area is densely vegetated. The majority of the vegetation is comprised of younger looking medium sized trees with thick under brush and vines, with the ground surface covered with a moderate layer of humus.

Evidence of clearing and ground disturbance was noted to the south and west of Loop Road on historical aerial photographs of the area. During the 1993 site visit, excavated ravines were observed west of Loop Road. These ravines contained construction debris and road asphalt. In general, ground disturbance and signs of past disposal practices were noted within and surrounding the Loop Road.

Currently, Loop Road is used as a fitness trail with exercise stations along the way. Evidence of military personnel activity and maneuvers such as trench digging, making sand bags, and rock crushing are present throughout the suspected disposal area.

2.2.2 Site History

The Site was reportedly utilized as a disposal facility for a period of 30 years from 1942 to 1973. An estimated 2,000 gallons of waste solvents were reportedly disposed of in this area. Approximately 100,000 cubic yards of various types of waste material (i.e., garbage, building debris and waste treatment sludge) were also reportedly disposed of here. The suspected disposal area, less than 5-acres in size, lies within a 30 to 40-acre area. Signs of activity (i.e. deforested areas), were identified in historical aerial photographs (ESE, 1990).

Photo #3. Access to monitoring well and sample locations at Site 68 was by dirt roads which meandered through the thick forest of the site.

Photo #4. The small drum is an example of surface debris found near soil boring location SB-01 at Site 68.

2.3 Site 75 - MCAS Basketball Court

2.3.1 Site Location and Setting

Site 75 is located at the MCAS, New River (Figure 1-1). The site is along the north side of Curtis Road between the Seaboard Coastline Railroad and Baxter Road. The study area is mostly a well-maintained grass field, divided in half by a wooded strip of land (approximately 40-50 feet wide) running east to west. Base personnel currently occupy housing units within and on the edge of the study area, along Baxter Road. Within the grass field on the north side of the wooded strip of land is a basketball court, which is almost the center of the study area. The study area reportedly contains an oval-shaped drum burial pit. The dimensions of the oval-shaped pit is reported to be 90 feet long and 70 feet wide; however, its exact location is unknown and the area is not immediately apparent (ESE, 1990).

2.3.2 Site History

Site 75 was reported to be a drum disposal area that was used on at least one occasion in the early 1950s. The excavation for the drum disposal was reported to be an oval shaped pit approximately 90 feet long by 70 feet wide and was sufficiently deep to have cut into the groundwater table approximately five feet bgs. An estimated seventy-five to one-hundred 55-gallon drums were reportedly placed in this pit. The drums reportedly contained a chloroacetophenone tear gas solution which was used for training. Additional VOCs such as chloroform, carbon tetrachloride, and benzene, along with chloropicirin may have also been present in the solution.

Photo #5. Site 75, MCAS Basketball Court. The basketball court itself can be seen just to the left of the roll-off box in the middle of the picture.

2.4 Site 76 - MCAS Curtis Road

2.4.1 Site Location and Setting

Site 76 is also located at the MCAS, New River (Figure 1-1). The site is along the north side of Curtis Road and is bounded by Curtis Road to the south, Compton and Grier Streets to the north, Crawford Street to the east, and Baxter Road to the west. The study area is a mixture of well maintained grassy areas and sparsely wooded areas. There are several housing units belonging to Base personnel to the immediate north of the Site 76 study area.

2.4.2 Site History

Similar to Site 75, Site 76 allegedly contains a dump site for drum disposal purposes. Although two locations within the study area have been identified as possible disposal sites based on interviews and review of historical aerial photographs, the exact location remains unknown. The alleged dump site was reportedly used as a drum disposal area on two occasions in 1949. The estimated area of the disposal pits is 1/4 acre, and approximately twenty-five to seventy-five 55-gallon drums were allegedly involved. It's believed that the drums contained a chloroacetophenone tear gas agent similar to that allegedly buried at MCAS Basketball Court, Site 75. Additional potential contaminants include: chloroform, carbon tetrachloride, benzene, and chloropicrin (ESE, 1990).

Photo #6. A partial view of Site 76, MCAS Curtis Road. Seen in the photo is actually Compton Street, the northern site boundary.

2.5 Site 84 - Building 45 Area

2.5.1 Site Location and Setting

Site 84 is located approximately 200 yards south of Highway 24 on the main side of MCB, Camp Lejeune, one mile west of the main gate entrance (Figure 1-1). The study area is bordered by Building 45 (an electrical substation) to the east and south, Northeast Creek to the west, and railroad tracks to the north. The site area is mostly wooded and vegetated covered by thick vegetation or grass. There is a small lagoon, possibly manmade, hidden by trees near the center of the site. The lagoon is roughly circular in shape with a diameter of approximately 50 feet. There is an unrestricted access road that runs through the site and terminates at Northeast Creek.

2.5.2 Site History

This site is in proximity of a former electric substation. Transformers reportedly containing polychlorinated biphenyls (PCBs) were known to be used and possibly stored at the substation. A transformer was discovered in the wooded area, east of the substation. Additional transformers (approximately 20) potentially containing PCB transformer oil were discovered and removed from the lagoon.

Photo #7. Lagoon where the PCB transformers were dumped.

2.6 Site 85 - Camp Johnson Battery Dump

2.6.1 Site Location and Setting

Site 85 is located within the Camp Johnson support operations area (Figure 1-1). The site is accessed from Coolidge Road to the south via a network of improved and unimproved roads. With the exception of the roads, the surrounding area is densely wooded and vegetated. The understory thick with brush and small trees (generally less than three inches in diameter). The area of concern is approximately 4.5 acres in size.

Currently, the roads that surround Site 85 are used for vehicle training and support operations. Tactical Landing Zone (TLZ) Mallard serves as a debarkation and landing point for aircraft involved in military personnel maneuvers.

2.6.2 Site History

Site 85 was used as a battery dump during the 1950s. Battery remnants, possibly from the Korean War era, were uncovered during road grading and remain visible in selected areas. During a site visit conducted by Baker personnel in September 1993, five distinct piles of battery packs were identified in this area. During sampling activities associated with this investigation two more piles of batteries were discovered. The battery piles are comprised of what appear to be severely corroded and/or burned individual batteries and battery packs. The battery packs are approximately 10-inches long and 5-inches wide. The piles of battery debris range in size from 2-foot wide by 2-foot long to 15-feet wide by 20-feet long. The piles vary from 1-foot to 3-feet high. Based on the identified piles, and field measurements with a hand held tape, the total volume of debris at the site has been estimated to be approximately 40 cubic yards.

Photo #8. The battery mounds of Site 85 are well hidden within the brush of this secluded area. Seven such mounds were located and investigated.

Photo #9. This is one of seven mounds of old batteries identified at Site 85.

Photo #10. Shown is a close up of a badly decomposed battery which is the typical condition of all the batteries found at the site.

2.7 Site 87 - MCAS Officer's Housing Area

2.7.1 Site Location and Setting

Site 87 is located in the MCAS Officer's Housing Area, near the intersection of Longstaff Road and Trotter Street, approximately 375 feet to the east, on the west bank of the New River (Figure 1-1). Some portions of the site are cleared, and some portions are densely vegetated with tress and brush.

Residents of the Officer's Housing Area have unrestricted access to this site. There are houses nearby, in fact, two homes (Buildings 2019 and 2021) are located immediately adjacent to the site. The site borders the New River which is used in this area for recreational purposes (e.g., fishing and boating). Ducks, herons, and fish have been observed in and on the water near the site.

2.7.2 Site History

Information on the history of Site 87 is limited. In 1986, during an investigation conducted by Environmental Science and Engineering, Inc. (ESE, 1990), waste was identified eroding from the cut bank along the New River in the vicinity of the Officer's Housing Area. The waste was tentatively identified as hospital wastes (i.e., hypodermic needles and vials of white powder). This white powder was believed to contain a chlorine-based substance (ESE, 1990).

Photo #11. The nearby overview of the digging of the test pits provided a continuous visual inspection for uncovered hazardous materials as well as health and safety monitoring. Note the closeness of the site to the New River.

3.0 FIELD INVESTIGATIONS

Section 3.0 provides a description of the field activities associated with the Pre-RI Screening Study. General activities and standard operating procedures followed the guidelines and protocols set forth in the Project Plans completed under Contract Task Order (CTO) 0193 dated January 1994. This section discusses general field activities conducted within each of the seven investigative areas.

3.1 Site-Specific Investigations

The investigative activities completed for the Pre-RI screening study varied by site depending upon individual site histories and the potential contaminants. The following table explains which tasks were completed at each of the sites.

Task	Site 12	Site 68	Site 75	Site 76	Site 84	Site 85	Site 87
Geophysical Survey			•	•			
Surface Soil Sampling	•	•	•	•	•	•	•
Drilling and Subsurface Soil Sampling	•	•	•	•		•	
Temporary Well Installation						•	•
Monitoring Well Development	•	•	•	•			•
Groundwater Sampling	•	•	•	•	•	•	•
Surface Wastes and Sediment Sampling		•			•		•
Exploratory Test Pits							•
Land Survey	•	•	•	•	•	•	•
Investigative Derived Waste Management	•	•	•	•	•	•	•

As requested by LANTDIV, the field activities for the Pre-RI Screening Study were completed during different time periods due to the need for data at several of the sites for the Relative Risk Ranking (RRR) System. The RRR System, developed by the Department of Defense (DoD), categorizers sites into High, Medium, and Low relative risk groups. Data was required at Sites 84, 85, and 87 for the RRR System before the scheduled start-up date for the overall field program under this CTO. Therefore, a portion of the field activities for the Pre-RI Screening Study was completed during August and October of 1995. The remaining field work for this investigation was completed in January and February of 1996. It is important to note that the data requirements for the RRR System did not adversely impact the objectives for the Pre-RI Screening Study. During each field task, applicable parts of the project plans were executed in the manner in which they were outlined, thereby completing the project objectives.

3.2 Investigative Procedures

3.2.1 Geophysical Survey

A geophysical survey was conducted at Sites 75 and 76 by GeoCenters, Inc. The objective of the survey was to explore the possibility that 55-gallon drums may have been buried at these sites in one or more pits.

A previous electromagnetic conductivity (EM) study was conducted at these sites; however, the investigation focused only on specific areas suspected to be burial locations and not the entire site. The suspect burial locations surveyed during the previous investigation were based upon aerial photographs. The previous investigation did not identify any areas representative of buried metallic objects. The geophysical survey that was completed during the Pre-RI Screening Study was performed while keeping three major objectives in mind:

- Examine the entire site, collecting data in all the accessible areas of the site. (The portable Surface Towed Ordnance Locator System (STOLS®) allows collection of data in normally in-accessible areas)

- Use of state-of-the art equipment, allowing collection of nearly continuous magnetic data

- Identify all targets (magnetic anomalies) and accurately locate them using global positioning system (GPS) technology.

The geophysical investigation for the Pre-RI Screening Study at Sites 75 and 76 were completed using the STOLS system coupled with GPS which tracks the instruments on a grid system over the entire site. These techniques guarantee a complete survey of the site and accurate identification of the magnetic data.

The portable STOLS instrument is mounted on a backpack and carried by one man who traverses the entire site following lines from a pre-determined grid system. Magnetic data are recorded continuously as the instrument passes over the ground. The information is mapped electronically according to the locations established by the GPS. The data are later downloaded and prepared for plotting on a hard copy. Typically, data collected in the field can be downloaded and plotted by the next days field operations allowing for continual data interpretation as the geophysical survey continues.

Photo #12 (above) and #13 (below) show the backpack mounted Geophysical equipment being towed in a grid pattern over Site 75.

3.2.2 Surface Soil Sampling

Surface soil samples were collected at Sites 12, 68, 75, 76, 84, 85, and 87. The surface soils were collected primarily for the purpose of risk evaluation and to determine the presence or absence of surficial contamination. The surface soil sample locations were chosen based upon the following criteria:

- Areas of contamination identified during previous investigations
- Areas of suspected disposal from historical information
- Field observations made during site visits or during the field investigations
- Review of historical aerial photographs
- Accessibility of areas

In general, the surface soil encountered was loosely packed, thus facilitating the use of a hand held stainless steel spoon for collecting samples. All of the surface soil samples were collected from single identified locations at depths of approximately four to twelve inches below ground surface (bgs). In cases where topsoil and/or a humus layer was present, the material was removed prior to sample collection. Volatile fractions were collected first while the remaining sample portion was homogenized and placed in the appropriate containers. The locations of the sample points were marked with wooden stakes which were labeled with the sample identification number.

Photo #14. Surface soil collection from beneath a mound of batteries at Site 85.

3.2.3 Drilling and Soil Sampling

Drilling and soil sampling activities were completed at Sites 12, 68, 75, 76, and 85. The drilling and soil sampling activities for the Pre-RI Screening Study involved two types of drilling techniques: 1) Direct-push (GeoProbe) methods and 2) Standard truck/track mounted drilling equipment. The direct-push soil borings were advanced for sample collection, description of subsurface units and at Site 85 for installation of temporary monitoring wells. The remaining borings completed by standard drilling techniques were advanced for the purpose of monitoring well installation. The sections below provide an overview of the drilling and soil sampling procedures.

3.2.3.1 Direct Push Soil Sampling

Direct-push soil sampling was performed at five of the sites (i.e., 12, 68, 75, 76, and 85) at locations. This sampling technique uses the GeoProbe drilling equipment mounted on the back of a four-wheel drive pick-up truck. The direct-push borings are advanced using either a truck-mounted GeoProbe or by a hand sampling device in areas where access is extremely limited. The GeoProbe advances a four-foot stainless steel collection tube lined with a dedicated sleeve by using a combination of mechanical hammering and downward hydraulic pressure. As the sampling tube is advanced below ground, soil is collected in the dedicated sleeve. The stainless steel tube is retrieved to the surface and the soil samples are extruded from the disposable sleeve. The sampling team examines the sample for classification and performs field screening with a photoionization detector (PID). Based upon the visual observations and field screening results certain samples are then selected for laboratory analyses.

Standard Truck/Track Mounted Drilling

Standard drilling methods were employed at Sites 12, 68, 75, and 76 to complete soil borings for monitoring well installation. Two different drilling methods were used. Shallow (Type II) monitoring wells were installed via hollow stem augering techniques and deep monitoring wells (Type III) were installed using mud rotary drilling. Initially, soil samples from the boreholes were collected using 2 3/4-inch inside diameter (ID) hollow stem augers. The small diameter augers were used to advance the borehole for sample collection only. Upon completion of the sampling activities, the borehole was reamed with 6 1/4 inch ID hollow stem augers in preparation for monitoring well construction.

Soil samples were collected via split-spoon sampling methods in general accordance with the procedures outlined in the American Society for Testing and Materials (ASTM) Standard Method for Penetration Test and Split-Barrel Sampling of Soils (Designation D 1586). Split-spoons of 24-inch (nominal) length were used throughout the investigation. Depending upon sample volume requirements, two-inch (nominal) outside diameter (OD) split-spoons or three-inch nominal OD split-spoons were used. Samples were collected continuously from the surface (i.e., ground surface to a depth of twelve inches) at two-foot intervals starting at one foot below ground surface. Continuous sample collection proceeded until the water table. Below this depth, samples were collected at various intervals that depended upon site conditions.

Photo #15. A few remote monitoring well locations required the use of an all terrain vehicle (ATV) mounted drill rig shown here at Site 68. The ATV proved more maneuverable and less venerable to damage than a conventional tire mounted drill rig.

Photo #16. The drilling subcontractor's mobile B-63 drill rig shown here was used on the majority of well installations conducted at the various investigative areas.

Each sample was classified in the field by a geologist using the Unified Soil Classification System (USCS) in accordance with the visual-manual methods described by the American Society for Testing and Materials (ASTM), 1993a). The field descriptions were recorded in a logbook and later transposed onto boring log records. Soil classification included characterization of soil type, grain size, color, moisture content, relative density, plasticity, and other pertinent information such as any indication of contamination. The Standard Penetration Test (SPT) blow counts were also recorded. In addition, a PID was used to screen the samples to detect the presence of specific analytes. Selected soil samples from each of the borings were submitted for laboratory analysis. Sample information such as boring number, sample identification, time and date of sample collection, field sampling team, and analytical parameters were recorded for each of the soil samples.

All soil sampling activities were performed in Level D personnel protective equipment. Soil cuttings generated during the soil investigation were collected, handled, and stored according to the procedures outlined in Pre-RI Report.

Photo #17 shows a soil sample collected from the GeoProbe work performed at Site 12. The sample will be examined and classified by the on-site Baker geologist and containerized for selected laboratory analysis.

Photo #18. Here a Baker geologist is examining a split spoon sample, a subsurface soil sample collected during the drilling for monitoring well installation.

3.2.4 Temporary Monitoring Well Installation

Temporary monitoring wells were installed at Sites 84 and 85 as part of the Pre-RI Screening Study. At Site 84, one temporary monitoring well was installed in November 1995 as part of the RRR System for the purposes of collecting a groundwater sample in the vicinity of the lagoon. The boring was advanced using a GeoProbe drill rig. Ten feet of one-inch outside diameter (OD) polyvinyl chloride (PVC) well screen with approximately five feet of riser was installed in the borehole. Once the screen was submerged, the temporary well was left to recharge.

At Site 85, three temporary monitoring wells were installed in August 1995 as part of the RRR System in the vicinity of the battery disposal piles. These wells were also installed using the GeoProbe direct-push technology. During installation, a 0.75 inch OD steel rod with three feet of slotted screen was push into the ground with the GeoProbe rig. Four foot sections of steel riser pipe were attached to the screen as the well was advanced. This procedure continued until the screened portion of the well bisected the water table. Once the screen was submerged, the temporary monitoring well was left for 15 minutes to up to 2.5 hours to recharge (depending upon soil conditions).

A peristaltic pump with disposable polyethylene tubing was used to collect the groundwater samples from the temporary monitoring wells at both sites. The samples were collected by pumping groundwater directly into sampling containers from the wells.

Photo #19. When the GeoProbe is used for groundwater sampling, a screened tip is placed on the end of small steel rods and pushed below ground surface using the GeoProbe. Disposable tubing is lowered through the steel rods and connected to a peristaltic pump as seen here. Groundwater is drawn through the tubing and into laboratory prepared bottles.

3.2.5 Monitoring Well Installation

Shallow (Type II) monitoring wells were installed at Sites 12, 68, 75 and 76 using a truck or track mounted drill rig depending upon site access. The wells were situated spatially to provide samples from potentially impacted groundwater, and to characterize the nature and extent of possible contamination. Existing and newly installed wells were used to collect groundwater samples and to evaluate groundwater flow patterns. Placement of the newly installed monitoring wells was based on review of aerial photographs, previous investigations, site conditions, the location of existing monitoring wells, and the overall scope and objectives of the project.

The shallow (Type II) wells were installed after a pilot hole for soil sampling was completed to the appropriate depth. Each borehole was reamed with 6 1/4-inch inside diameter (ID) hollow stem augers prior to well installation. Shallow well depths ranged from 14 to 20 feet below ground surface. In general, the shallow wells were installed approximately 10 feet below the water table encountered during the pilot hole test boring. Shallow monitoring wells were installed with screened intervals bisecting the water table sufficiently to compensate for seasonal variations in the water table which, based upon previous studies conducted by Baker at Camp Lejeune, is known to fluctuate from two to four feet.

Four deep (Type III) wells were installed at Site 68 to characterize the groundwater below a semi-confining clay layer (known as the "Castle Hayne Confining Unit") present at the site. Upon completion of the pilot hole test boring drilled for soil sample collection, the borings were reamed with 6 1/4-inch hollow stem augers. A 6-inch steel surface casing was then grouted approximately two feet into the identified clay layer. The boring was then completed using mud rotary drilling with a tri-cone roller bit. The four deep monitoring wells at Site 68 were screened at intervals just below the semi-confining clay layer. Screened intervals for the deep wells ranged from 19.5 to 60 feet below ground surface.

All of the monitoring wells were constructed of two-inch diameter, Schedule 40, flush-joint and threaded, PVC casing. The wells utilized either a 10-foot (deep wells) or a 15-foot (shallow wells) screened interval of No. 10 (i.e., 0.010 inch) slotted screen sections. A fine-grained sand pack (i.e., No. 1 silica sand), extending approximately 2 feet above the top to the screen, was placed in the annulus between the screen and the borehole wall from inside the augers during well installation. The sand pack was poured manually down the borehole during well installation and checked continuously with a weighted tape measure to determine the depth of the sand. A two- to three-foot bentonite pellet seal was placed on top of the sand pack by pouring the pellets down the borehole. The bentonite pellets were hydrated with potable water after placement. The seal was installed to prevent cement of surface run-off from entering the sand pack. The remaining annular space was backfilled with a mixture of Portland cement and powdered bentonite. The "stick-up" wells (Sites 12 and 68) were completed by placing a four-inch protective steel casing with locking cover over the well and into the cement. A five-foot by five-foot concrete pad was placed around the protective casing and four protective bollard posts were installed around the corners of the concrete pad. Well tags, which provide construction information, were installed at the top of each well.

The shallow monitoring wells at Sites 75 and 76 were completed flush with existing grade by placing a steel cover with a bolt down lid over the well. The "flush-mount" cover was set in a 2-foot by 2-foot concrete pad. Well tags, which provide construction information, were placed inside the steel cover at each of the wells.

Photo #20 (above) and #21 (below) shows the drillers setting the 2-inch casing that will become the monitoring well. Once the PVC is in place and pack added, the augers, which are still in the ground, will be removed.

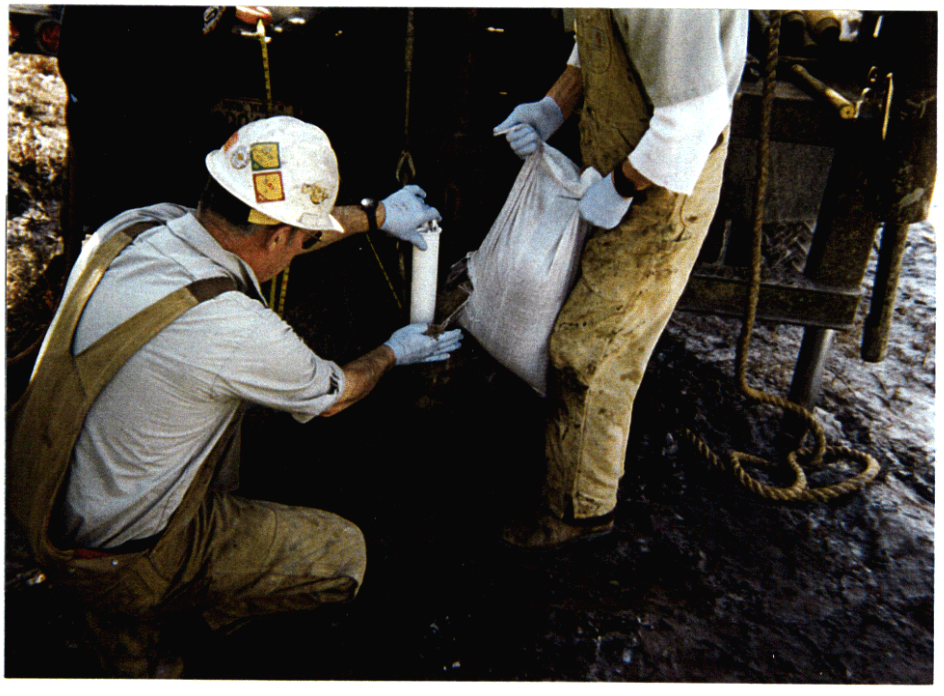

Photo #22 (above) shows the monitoring well's protective casing installed prior to the completion of the concrete pad with protective bollards seen below (Photo #23).

3.2.6 Monitoring Well Development

Following well construction and curing of the bentonite seal and cement grout, each newly installed well was developed to remove fine-grained sediment from the screen/sandpack and to establish interconnection between the well and the surrounding formation. Existing wells at Sites 68, 75, 76, and 87 were also re-developed prior to purging and sampling activities to remove accumulated sediment from the wells. Each of the wells were developed by a combination of surging and pumping. The groundwater recovered during well development was temporarily stored in drums, then transferred into on-site storage tanks. Pumping hoses, made of flexible polyethylene (PE) were used once at each well and discarded to minimize the potential for cross contamination.

A minimum of 3 to 5 borehole volumes were evacuated from each well. Where conditions permitted, purging continued until the groundwater was essentially sediment-free. Measurements of pH, specific conductance, temperature, and turbidity were recorded after each well volume was removed to assist is assessing well stabilization. Additionally, periodic flow and volume measurements were recorded during development to evaluate flow rates of the aquifer.

Photo #24. Monitoring well development at Site 12. Note the electric powered blue Waterra Pump strapped to the side of the monitoring well.

3.2.7 Groundwater Sampling

Groundwater samples were collected from new and existing monitoring wells at Sites 12, 68, 75, 76, 85, and 87 as part of the Pre-RI Screening Study to confirm the presence or absence of contaminants and evaluate overall groundwater chemistry. Low flow pumping was used to collect the samples from all of the monitoring wells.

Prior to purging, a static water level measurement from each well was obtained. The total well depth was also recorded from each well to the nearest 0.1 foot using a decontaminated steel tape. The static water level and well depth measurements were used to calculate the volume of water in each well.

A minimum of three to five well volumes were removed during purging activities prior to sample collection. Measurements of pH, specific conductance, temperature, dissolved oxygen (DO), and turbidity were taken after each well volume was removed to ensure that the groundwater characteristics had stabilized before sample collection. Purge water generated during sampling activities was contained and handled as described in the Pre-RI Report.

As mentioned above, groundwater sampling was completed using a low flow well purging and sampling technique. This sampling methodology was developed in response to conversations with USEPA Region IV personnel in Athens, Georgia. A surface peristaltic pump (GeoPump), with the intake set two to three feet into the static water column, was used to purge each of the wells. While purging groundwater from each of the monitoring wells, a flow rate of less than 0.25 gallons per minute (gpm) was maintained. Samples collected for both organic and inorganic analyses were obtained directly from the pump discharge. Dedicated Teflon and silicon tubing was used during purging and sampling activities at each well. Rinsate blanks were collected from the Teflon and silicon tubing to verify that the tubing did not introduce any contaminants during sample collection.

Preparation of groundwater samples incorporated procedures similar to those described for soil samples. Sample information including well number, sample identification, time and date of sample collection, field sampling team, and analytical parameters was recorded in a field logbook and on the sample labels. Chain-of-custody documentation accompanied the samples to the laboratory.

Photo #25. Sample acquisition of groundwater was performed with the use of a peristaltic pump and collected in laboratory prepared bottles.

Photo #26. During the development and sampling of the monitoring wells, field measurements of temperature, specific conductivity, pH, dissolved oxygen, and turbidity were conducted to ensure proper water stabilization prior to sample collection.

3.2.8 Surface Water and Sediment Sampling

Surface water and sediment samples were collected at Sites 84 and 87 in October 1995, and at Site 68 during January, 1996. Both upstream and downstream locations from the suspected disposal areas were sampled during the investigations. Specific areas sampled were based on surface water drainage preferences, groundwater flow patterns, and accessibility to stream areas. The following sections describe the sampling locations, sampling procedures, analytical program, and quality assurance and quality control program.

3.2.8.1 Surface Water Sampling Procedures

Sampling of the surface water and sediments was completed by starting at the downstream sample locations first and then proceeding upstream. Each of the sampling stations were demarcated along the shoreline with wooden stakes labeled with the sample identification.

At each of the surface water sampling stations, samples were collected by dipping the laboratory containers directly into the water. Samples analyzed for volatiles were obtained first, and samples for the additional analytical fractions were collected immediately following. During sample collection care was taken to avoid excessive agitation that may result in loss of the volatile organic compounds (VOCs). Water quality readings were taken at each sampling station (i.e., pH, dissolved oxygen, salinity, specific conductance, and temperature).

3.2.8.2 Sediment Sampling Procedures

The corresponding sediment samples were collected subsequent to the surface water samples to minimize sediment suspension that might falsely contaminate the samples. Sediment samples were collected from the surface to approximately six inches using a stainless steel sampling spoon. Volatile fractions were collected first while the remaining sample portion was thoroughly homogenized, and then placed in the appropriate sample containers.

3.2.9 Exploratory Test Pits

A total of four exploratory test pits were completed at Site 87. The test pit investigation was conducted to assess the nature of buried material within the suspected disposal area at Site 87. The exact test pit locations were identified in the field through visual site inspection between the Baker Site Manager and a representative of MCB, Camp Lejeune, EMD. The test pits were positioned as close to the edge of the bank of the New River and were oriented in such a way as to provide the greatest amount of coverage over the suspected burial area.

The test pits ranged in length of 26 to 44 feet and were approximately two feet wide. Each of the test pits were terminated at the water table which was approximately eight feet below ground surface. Excavation logs describing the soil conditions of each test pit were maintained during field operations. In addition, the test pitting activities were recorded with a video tape.

Level B personal protective equipment (e.g., positive pressure face mask with supplied air) was used during the excavation of the exploratory test pits.

Photo #27. Sediment sampling of a creek deep within Site 68.

Photo #28. This worker (wearing Level B protection) is collecting a subsurface soil sample taken from an exploratory test pit at Site 87. OSHA safety requirements prohibit workers from entering the excavation, therefore, soil was brought to the surface and collected from the middle of the backhoe bucket.

Photo #29. Looking into one of the test pits excavated at Site 87.

3.2.10 Land Survey

A land survey was conducted by Lanier Surveying, a licensed professional surveyor in the State of North Carolina, under the direction of the Baker Site Manager. Sites 12, 68, 75, 76, 84, 85 and 87 were surveyed as part of this investigation. Monitoring well locations (new and existing), surface soil, subsurface soil and surface water/sediment sample location points were surveyed for vertical and horizontal control using North Carolina State Plane Coordinates.

Photo #30. GPS receivers used for locating the position of detected metallic objects from the geophysical survey at Site 75.

4.0 REFERENCES

Environmental Science and Engineering, Inc. (ESE). 1990. Site Summary Report, Final Marine Corps Base, Camp Lejeune, North Carolina. Prepared for the Department of the Navy, Naval Facilities engineering Command, Atlantic Division, Norfolk, Virginia. ESE Project No. 49-02036.